

AIRS hyper-spectral measurements for climate research:  
Carbon dioxide and nitrous oxide effects [\[1\]](#)

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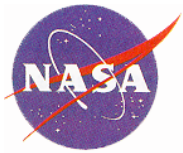
The JPL logo, consisting of the letters "JPL" in a bold, red, sans-serif font.



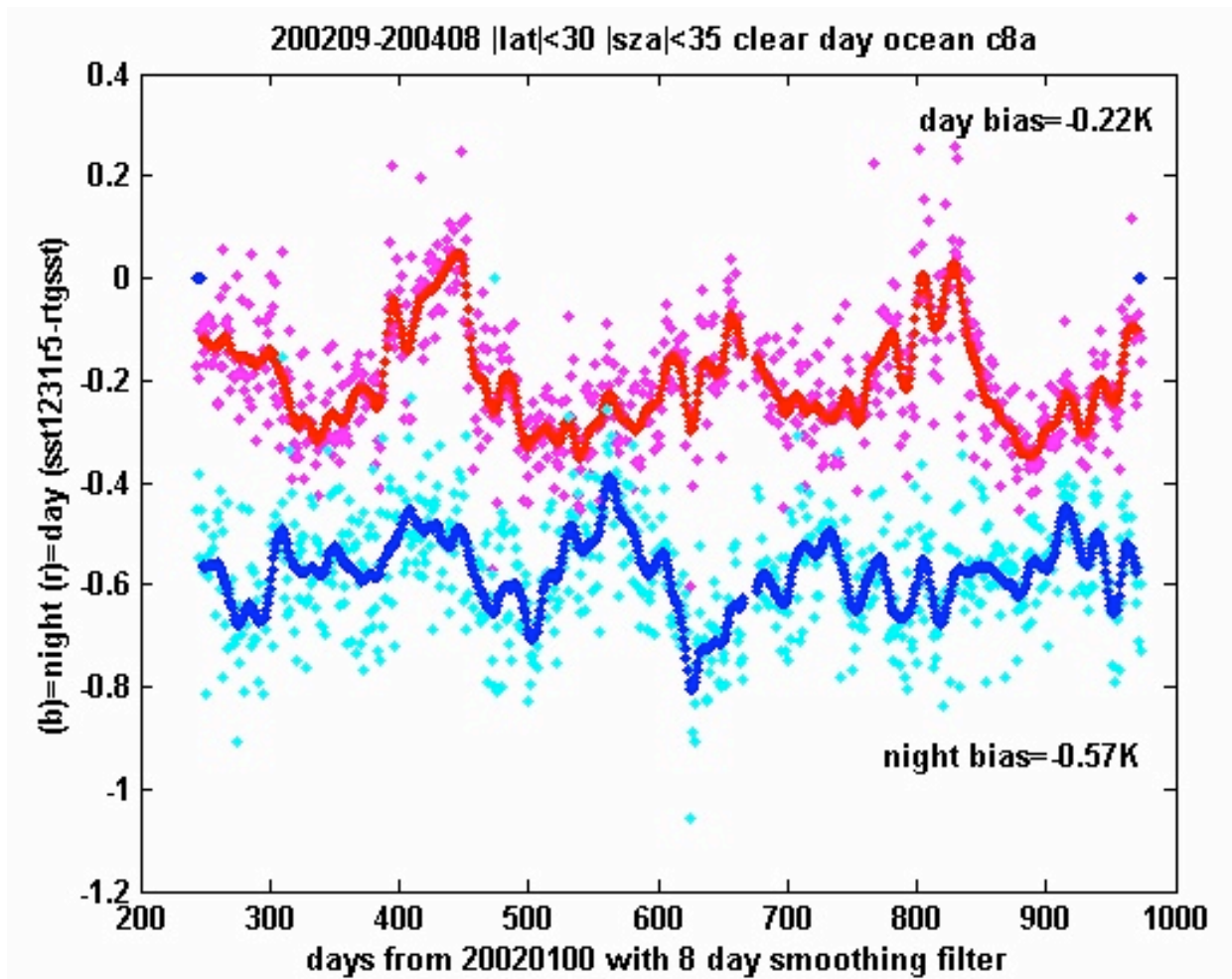
**The AIRS Calibration Data Set contains for currently two years  
for all clear ocean spectra**

**84 key AIRS channels  
15 AMSU channels interpolated to the AIRS footprint  
vis1,2,3 averaged to the AIRS footprint.  
matchup with RTG.SST  
lon. lat, sza, solzen, etc.**

**about 100,000 spectra per day**

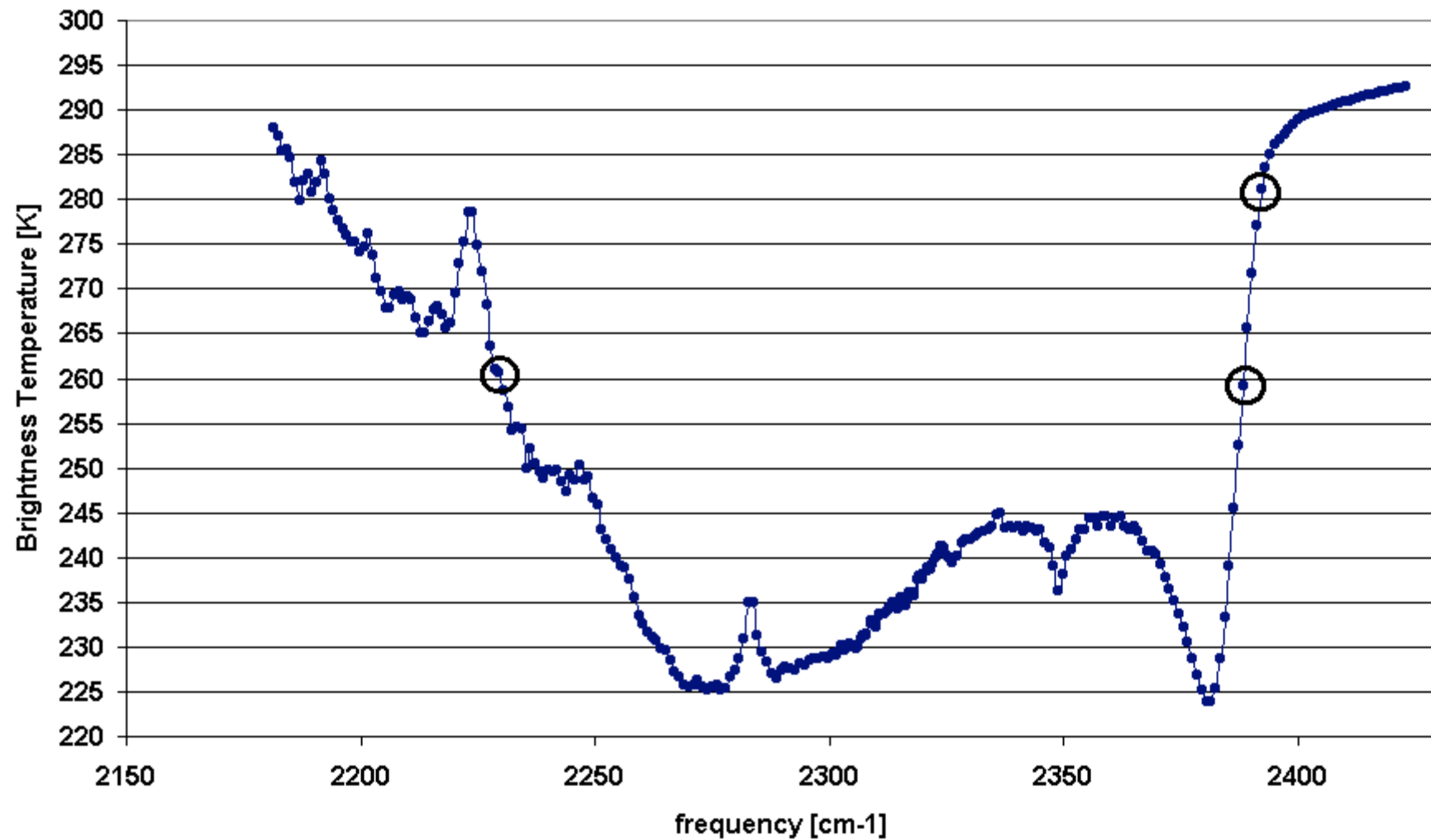


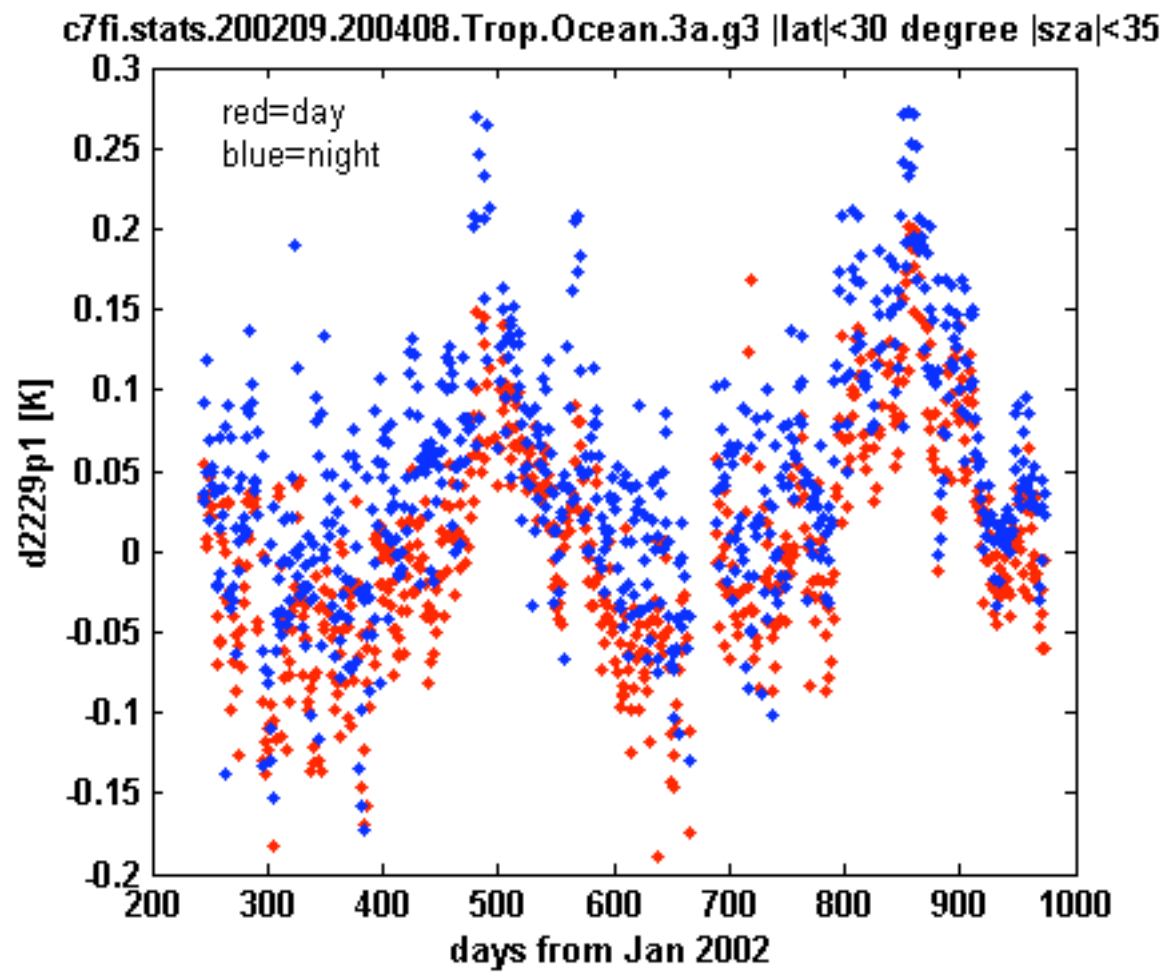
## Stability is better than 8 mK/year

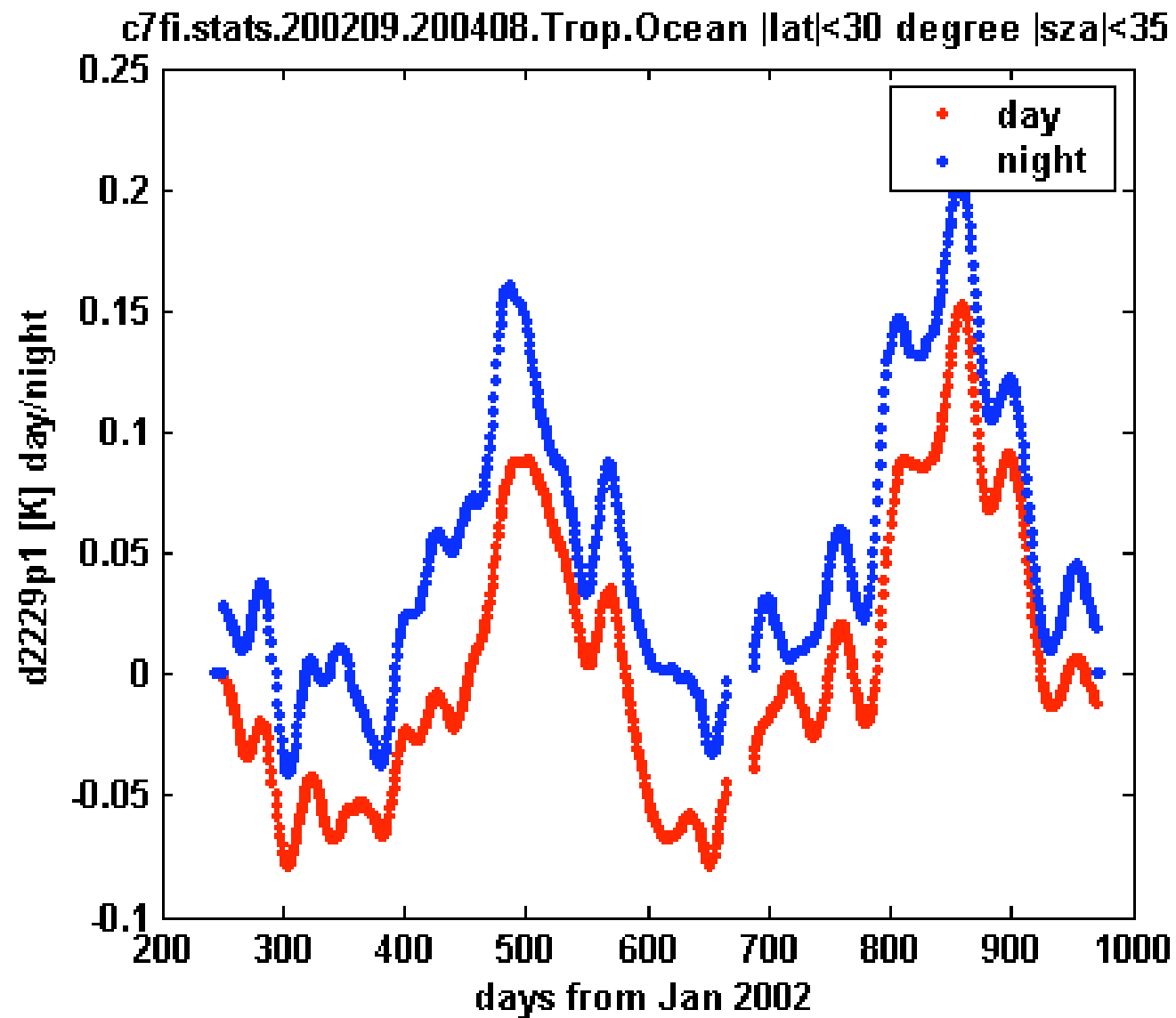
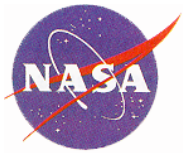


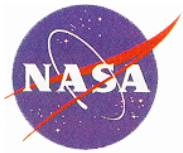


## AIRS shortwave sounding region for tropical ocean









The annual trend and formal trend uncertainty estimates are

$d2229 = 64 \pm 6$  mK/year for day data

$d2229 = 52 \pm 6$  mK/year for night data

The day/night average is  $58 \pm 8$  mK/year

We ignored the day/night shift of 100mK due to non-LTE at bt2388.

There is an SRF shift of  $0.5 \pm 0.5$  ppmf/year  
requiring a correction to  $d2229$  is  $(+5 \pm 5)$  mK/year.

The trend to be explained,  $63 \pm 10$  mK/year

The trend can be explained due to the combination of the increase  
in the  $\text{CO}_2$  and  $\text{N}_2\text{O}$  abundance



**bt2229 has sensitivity to n<sub>2</sub>o**

**bt2229 gets colder by 37 mK/ppbv under tropical ocean conditions.**

**The n<sub>2</sub> column abundance of 318 ppbv, increasing at the rate of  $0.6 \pm 0.2$  ppbv/year.**

**The change in the n<sub>2</sub>o abundance produces an annual trend of**

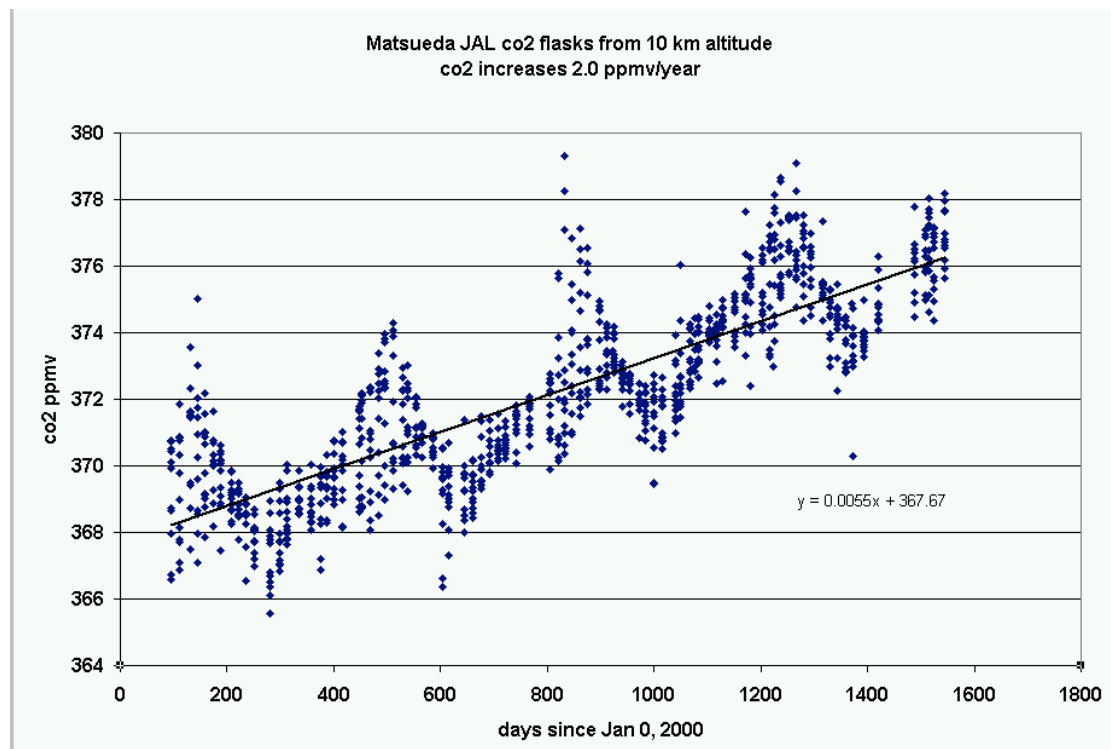
**$37 \times (0.6 \pm 0.2) = 22 \pm 7$  mK/year**



bt2388 is much more sensitive to the co2 column change than bt2229. The net sensitivity of d2229 is 37 mK/ppmv co2

Based on Matsueda's co2 flask measurements the annual amount of co2 increase is currently  $2.2 \pm 0.4$  ppmv/year

This annual increase in the co2 abundance results in a trend in d2229 of  $37 \times (2.2 \pm 0.4) = 82 \pm 15$  mK/year.





observed after correction for SRF centroid  $63 \pm 10$  mK/year

combined effect of  $\text{CO}_2$  and  $\text{N}_2\text{O}$  is  $(82 \pm 15) - (22 \pm 7) = 60 \pm 18$  mK/year

Observation explained. End of GRL paper.



**The credible sensitivity to trends after two years  
of AIRS data is about 10 mK/year.  
We are now looking for other trends.**

**Lapse rate at 5 km altitude, water column above 5 km altitude?**

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Is the onset of El Nino visible in the AIRS data in a correlation between  
WP warm pool and NE Pacific before it is detected by other means?**



